

Development of a Simple Procedure for Tuning Controller Constants for Automatic Upstream Control of Canal Check Structures

Goal: Enable irrigation districts and their consulting engineers to easily automate canal gates for automatic upstream water level control. This type of control will maintain a constant pressure on farmer turnouts. In turn, this enables an irrigation district to provide more flexible and reliable deliveries to the farm.

Technology Path: Perhaps 80% of the irrigation districts in California have canals; almost 100% of those canals are canals under "manual upstream control". Within the past 10 years, excellent technologies for canal automation have been developed. These include:

- Proportional-Integral (PI) controllers for those canal check gates,
- Improved water level sensors, and
- Supervisory Control and Data Acquisition (SCADA) systems.

All of these are necessary for automating these control gates so that the irrigation districts can operate with more flexible deliveries while still maintaining the proper water levels in their canals. But what is missing for simple implementation of automatic upstream control is the control logic that must be programmed into the PI controllers (i.e., the on-site computers that are housed at each automatic gate). What this means is fairly simple - the controllers have in them a PI control equation that has 4 "tuning constants". The challenge is in determining the optimum values of those 4 constants. One cannot determine them by "field experience" if there are more than 2-3 check structures in series. Unless the constants are correct, the check gates will cycle too quickly or too slowly, resulting in catastrophic damage to the canal due to overtopping.

Recent research (Burt et al 1998) has made major advances in the theory of controller constant tuning, but the proper tuning still requires detailed modeling of the canal and the gates for every new situation - a major cost. Furthermore, there are almost no companies or individuals that are qualified to do the required, complex unsteady flow modeling. This research will attempt to simplify the tuning procedure and break the bottleneck.

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